# PATENT SPECIFICATION

1,193,678

DRAWINGS ATTACHED

1,193,678

*Date of Application and filing Complete Specification: 2 Aug. 1967*
*No. 35511/67*

*Application made in United States of America (No. 587357) on 16 Sept. 1966*

*Complete Specification Published: 3 June 1970*

**Index at acceptance:—F2 P(1A18B, 1B6, 1B8, 2A3, 2C1, 2C2, 2C10)**

**Int. Cl.:—F 16 l 11/00**

## COMPLETE SPECIFICATION

## Forming Tube Suitable for Winding Glass Fibers

We, SONOCO PRODUCTS COMPANY, a Company organized and existing under the laws of the State of South Carolina, United States of America, of Hartsville, South Carolina, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a carrier or "forming tube" suitable for use in the winding of freshly spun glass filaments or fibers.

In the spinning of glass fibers to be processed into textile material such as yarn and the like, glass in a molten condition is drawn through small openings or orifices in a plate commonly referred to as a spinneret into the form of continuous filaments which solidify upon contact with the air. These continuously drawn filaments are wound onto a tubular carrier in the form of a flexible cylindrical sleeve which is generally referred to as a "forming tube". In a glass fiber spinning operation, this forming tube is slipped onto a spindle or the like which is rotated at very high speeds, frequently around 8,000 to 10,000 r.p.m. and up, and the glass filaments are drawn from the spinneret and wound on the tube at a relatively high linear speed generally 3000 to 3600 m per minute and more. These forming tubes are used not only for such a winding operation, but for subsequent winding and unwinding operations as well.

Due to the high speed at which the forming tube is rotated and the rugged conditions of use to which it is subjected, these tubes must meet rigid standards and preferably should be of a suitable design and material so as not only to be inexpensive in initial cost, but to be capable of repeated use. Furthermore, these forming tubes must be provided with external surface characteristics specifically suitable for the glass fiber winding and unwinding operations with which they are used. In general, it can be said that such tubes are required to have a relatively smooth peripheral surface to permit the glass fibers to be readily unwound from the tube and at the same time this peripheral surface should be sufficiently rough so that satisfactory winding of the fibers on the tube may be accomplished. In addition, these tubes should also be of light weight to avoid deformation by centrifugal force which, at the speeds referred to above, is of a substantial magnitude. Furthermore, these forming tubes should by highly resistant to compression by the fibers wound tightly on the tube so that the tube maintains its shape after removal from the spindle and the tubes should have sufficient flexibility and elasticity to permit their ready removal from the wound package of glass fibers when the tube is to be re-used.

Two commonly employed materials in use today for making such forming tubes are plain paper or paperboard and plastics material such as polyethylene. Forming tubes of plastics material have been used with some success, but the severe stresses to which plastics material forming tubes are subjected frequently cause the plastics material tubes to disintegrate or "explode" during use primarily as a result of centrifugal force not only creating a hazard but, as a result of the high initial cost of such plastics material tubes, add considerably to manufacturing costs. Although a forming tube composed solely of ordinary paperboard generally performs satisfactorily the first time it is used, its inherent lack of strength causes it to deteriorate rapidly when re-used. It is thought that the rapid deterioration of forming tubes made from paper occurs primarily as a result of the breaking of the cellulosic fibers in the tube resulting from the bending and folding to which such paper tubes are subjected. Therefore, forming tubes of fibrous material such as paper or paperboard are generally discarded after a

[*Price 5s.*]

few uses or preferably after a single use so that it is highly desirable that the initial cost of such paper forming tubes be as low as possible so as to maintain manufacturing costs of glass fibers at a reasonable economic level. Paper forming tubes available today are generally formed of a plurality of plies of plain paper or paperboard so that the cost of winding such tubes as well as the paper materials employed is rather costly. Furthermore, in glass fiber manufacturing operations damp, moist conditions are usually prevalent which seriously reduce the strength of a plain paper forming tube. Moreover, freshly formed glass fibers are frequently coated with various materials which produce a sticking of the glass fibers to plain paper tubes with its attendant destructive effect.

The present invention provides a non-rigid forming tube, suitable for use in winding glass fibers, formed of a single, spirally wound ply of flexible strip material having deckled side edges, said strip being wound with the edges of adjacent convolutions in overlapping relationship with adhesive therebetween to form a flexible tube which is readily collapsible longitudinally so that it can be removed from a package of glass fibers wound on the forming tube.

The invention will be illustratively described with reference to the accompanying drawing in which:

Figure 1 is a diagrammatic illustration of tube winding apparatus for winding the forming tube of the invention;

Figure 2 is an enlarged isometric view of a portion of the apparatus of Figure 1;

Figure 3 is a sectional view taken substantially along line 3-3 of Figure 2 in the direction of the arrows; and

Figure 4 is an isometric view showing the forming tube of the invention in a collapsed condition.

Referring now to the drawing and to Figure 1 in particular, there is shown diagrammatically a spiral tube winding apparatus by means of which the forming tube of the invention is wound. The forming tube of the invention is designated generally by the numeral 11 in Figure 4. As previously referred to the forming tube 11 is of the type which is particularly suitable for use in the winding of freshly spun glass filaments or fibers drawn from the spinneret of a glass furnace. However, the forming tube 11 may also be employed in other glass fiber manufacturing operations involving glass fiber winding and take-off procedures.

As generally illustrative of the method of winding the forming tube 11 of the invention, the spiral tube winding apparatus of Figure 1 is designated generally by the numeral 12. In Figure 1, the spiral tube winding apparatus 12 produces a continuous tube T which is advanced in the direction of the arrow I as it rotates in the conventional manner. The tube T is cut into suitable lengths to form the forming tube 11 of the invention as will be explained hereinafter.

As is well known, the spiral tube winding apparatus 12 comprises a frame 13, a stationary winding mandrel 14 supported on the frame, a flexible endless belt 16 extending around a pair of pulleys 17 at least one of which is driven for rotating and advancing the tube T as it is formed. Associated with the winding apparatus 12 is a liquid applicator designated generally by the numeral 21 and a cutoff device designated generally by the numeral 22 for cutting the continuously wound tube T into uniform sections of a selected length.

In the winding of the continuous tube T, a strip 23 of fibrous material such as paper unwound from a supply roll 24 is spirally wound onto the mandrel 14. The paper strip 23 is wound with the edges of adjacent convolutions in overlapping relationship with adhesive therebetween to permanently retain the strip 23 in the form of the spirally wound tube T.

The side edges of strip 23 are deckled on opposite sides of the strip so that the resulting spirally wound tube T is of uniform thickness throughout when the deckled edges of the strip 23 are overlapped. As shown best in Figure 1, the strip 23 is provided with deckled edges 26, 27 which, when overlapped, form a spiral seam 28 on the tube T.

In order to glue the edges 26, 27 together, a glue applicator 31 of any suitable type is provided which is arranged to contain an adhesive in which an applicator roll 32 is immersed. The paper strip 23 unwound from the roll 24 has its edge 27 in contact with the applicator roll 32 and as the roll 32 is rotated by the moving strip 23, the deckled edge 27 has transferred thereto a coating of adhesive. The advancing strip 23 is preferably guided and maintained in contact with the applicator roll 32 by means of suitable guide rods 33, 34.

In order to provide a coating of water repellent material on the tube T, applicator device 21 is provided which may be of any suitable construction. In the preferred embodiment, the applicator 21 includes a reservoir 36 having a removable cover 37 which is provided with a lower slotted opening 38 through which the material contained within the reservoir 36 is permitted to flow. A suitable valve (not shown) is provided for controlling the material flow through the opening 38. The position of the valve may be regulated by means of a knob 39. A "wick" 41 of absorbent material is supported at its upper end on the reservoir 36 adjacent the opening 38 so that the material in the reservoir 36 flows onto the wick 41. The wick 41 is therefore saturated with the water repellent material and the wick remains in contact with the tube T to coat its exterior surface 42 accordingly as it rotates in the direction of the arrow P and moves in the direction of the arrow I. Excess water repellent material from the wick 41 drips into a suitably supported pan 43 and the water repellent material is continuously conveyed from the pan 43 back to the reservoir 36 by means of a conduit 44 having a pump 46 therein.

In the winding of the continuous tube T, the strip 23 is unwound from the roll 24 with its deckled edge 27 moving over the applicator roll 32 to continuously receive a coating of adhesive contained within the glue applicator 31. The strip 23 is spirally wound onto the mandrel 14 with the deckled edges 26, 27 in overlapping relationship with adhesive therebetween, so that the single ply formed by the strip 23 is retained in the form of the tube T. The tube T passes under the belt 16 which both rotates the tube in the direction of the arrow P and advances it in the direction of the arrow I.

As the tube T moves through the water repellent material applicator 21, its outer surface 42 is wiped by the wick 41 saturated with the water repellent material so that a coating 45 of water repellent material is formed on the outer surface of tube T. When the continuously formed tube T has reached the cutoff device 22, the adhesive between the deckled edges 26, 27 has substantially set and the coating 45 of water repellent material on the tube T has substantially dried. The tube T moving in the direction of arrow I now enters the cutoff device 22 in which it is cut into a plurality of short lengths preferably lengths of approximately 20 cm to provide forming tubes 11 of a length suitable for use in a glass fiber winding and unwinding operation.

It can be seen that there has been provided with the invention a forming tube which may be wound in a simple and easy manner using spiral tube winding apparatus with only a single ply of paper and a minimum amount of adhesive. Not only is a forming tube of the invention characterized by high strength and flexibility, but its method of manufacture and its use of a minimum of materials make it exceptionally low in cost so as to permit it to be readily discarded after a single use. The forming tube of the invention performs in an outstanding manner when used in the winding and unwinding of glass fibers and since it need not be re-used, it provides a virtually trouble-free carrier for such glass fibers. The provision of a coating of water repellent material on the forming tube of the invention not only imparts a high degree of wet strength to the paper forming tube, but protects the tube against various materials contained in the glass fibers wound thereon so that deterioration of the tube during use is eliminated thereby eliminating potential sources of trouble in the use of a forming tube of paper in such an operation.

WHAT WE CLAIM IS:—

1. A non-rigid forming tube, suitable for use in winding glass fibers formed of a single, spirally wound ply of flexible strip material having deckled side edges, said strip being wound with the edges of adjacent convolutions in overlapping relationship with adhesive therebetween to form a flexible tube which is readily collapsible longitudinally so that it can be removed from a package of glass fibers wound on the forming tube.

2. A non-rigid forming tube according to claim 1, wherein the side edges of the spirally wound ply are deckled on opposite sides of the ply.

3. A non-rigid forming tube according to claim 1 or 2 wherein the single, spirally wound ply is formed from a fibrous material.

4. A non-rigid forming tube according to claim 3 wherein said fibrous material is paper.

5. A non-rigid forming tube according to any of claims 1 to 3, wherein a coating of water repellent material is applied on the outer surface of the forming tube.

6. A non-rigid forming tube substantially as herein described with reference to and as illustrated in the accompanying drawing.

For the Applicants:
A. POOLE & Co.,
Chartered Patent Agents,
19 Devonshire Street,
London, W.1.

(7340) Printed by Her Majesty's Stationery Office Press, Edinburgh, 1970.
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY,
from which copies may be obtained.

BEST AVAILABLE COPY

1193678 COMPLETE SPECIFICATION
1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

FIG.1.

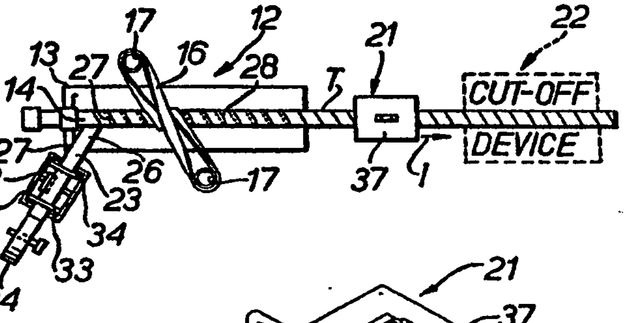
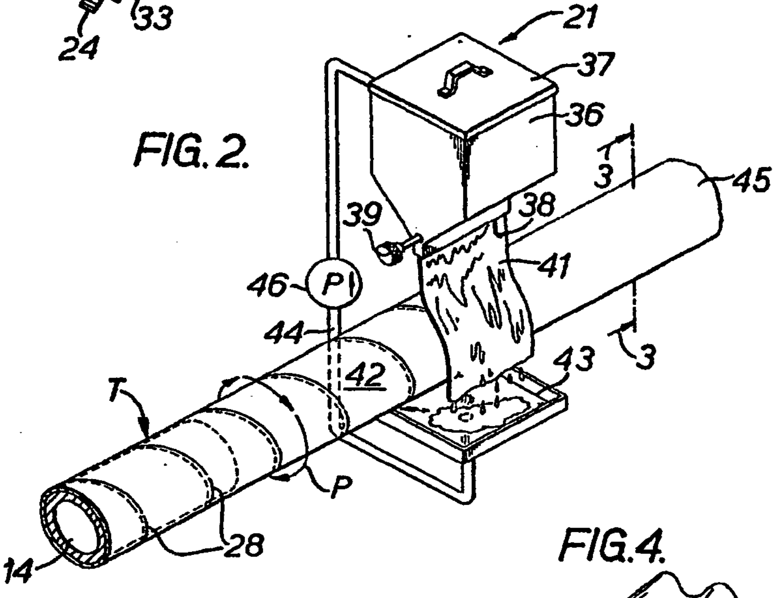


FIG. 2.



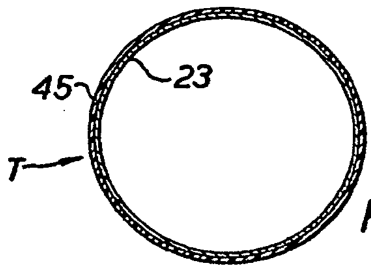


FIG.3.

FIG.4.